SPECIAL USES OF SPRINKLER IRRIGATION EQUIPMENT

Waste Disposal by Sprinklers

Disposing of waste on land is not a new concept. Crops have been grown for centruies on land used for spreading manure and sewage. These materials were regarded as fertilizers, not wastes. Many kinds of grasses, vegetables, legumes, and woody plants have been subjected to waste disposal. Grass seems to be the most effective vegetation for this purpose. Many species of grass possess a high water use factor combined with abundant root production. The roots and sod retard runoff and enhance infiltration. The plant leaves pump water back into the atmosphere. Wastes become pollutants when they are introduced into the air, water, or soil in excessive amounts or otherwise become offensive in the environment.

The interaction of soils, plants, and water must be thoroughly considered before a sprinkler disposal system is installed and expected to operate successfully.

Generally, an existing irrigation system can be utilized to apply effluent to the land. The sprinkler nozzle will need to be large enough to pass the solids that are in the effluent. One of the major problems associated with sprinkler application is the corrosive nature of the effluent.

Nitrogen seems to be the most critical of the nutrients in livestock waste and, therefore, the controlling factor. When livestock waste is applied to cropland, the total nitrogen produced by the animal can be used as a guide for determining the total application to each acre without excess buildup of nitrates.

The depth of application should be such that polluted waters will not be forced into ground water supplies or runoff will occur to pollute surface water. The depth of application will be determined by the specific pollution potential, the intake rate of the soil, depth of soil, crop use of water, and climatic conditions such as temperature and rainfall. Generally, when slurry waste is applied to the land, it is best to plan for an application of one (1) inch or less. This is suggested because solids in the material soon form a sealing layer on the surface and severely restrict intake. If allowed to dry, this layer will flake and crack and again permit normal intake. If lagoon or holding pond effluent disposal is the primary purpose, an appliation depth up to 2.0 inches may be satisfactory.

The total depth of effluent application per season can be determined when the concentration of total N in the effluent water is known.

Application rates must be selected to fit the sprinkler intake rate of the soil. Application rates should not exceed the rates shown in Table 5.2 of this guide or the values given below for heavier soils not listed in Table 5.2.

Soil	With Cover	Bare
Clay soils; very poorly drained	0.3 in./hr.	0.15 in./hr.
Silty surface; poorly drained clay and clay pan soils	0.4 in./hr.	0.25 in./hr.

These rates apply to soils with slopes less than 2 percent, the soil is dry (no precipitation in previous two (2) days during the growing season) and applied in light applications (½ to 1"). When effluent disposal is planned, especially on the heavier soils, extreme care must be exercised to plan drainage systems that will dispose of excess runoff without causing erosion or pollution. Examples of this might be to divert water from higher land and provision for spreading and overland flow of the excess runoff from the disposal area through a grass buffer or filter zone before access to surface waterways are reached.

Some of the critical considerations of sprinkler application of effluent follows:

1. Excessive rate or volume of application may result in runoff and pollution of surface water.

2. Excessive application depths may result in pollution of ground water especially on highly permeable soils.

3. Effluent may contain toxic or detrimental materials to soil or plants.

4. Odors from sprinkling may be obnoxious.

5. Effluent is highly corrosive and may shorten the useful life of equipment.

6. Solids from the effluent may coat plant leaves and reduce photosynthesis.

The system should be operated with clear water for at least 15 minutes to wash the system as well as remove solids off of the plants.

Water driven self-propelled systems should not be used for waste disposal.

Frost Protection

There are several methods of frost protection. The most widespread and effective measure for protection of close growing crops is sprinkler irrigation. The ordinary sprinkler system needs adaptation to be effective for this purpose.

Two types of frost are advection and radiation. Advection frosts are accompanied by wind. They are not limited to nighttime hours as radiation frosts usually are. Advection frosts are caused by a mass of below freezing air moving into and through the area. They are often more severe and last longer than radiation frosts. Sprinkling for protection against an advection frost is seldom successful.

Radiation frost usually occurs on clear, cold, dry, and calm nights. They are characterized by a net loss of radiant energy to the atmosphere from soil and plants. The colder temperatures are near the earth surface and increase as the distance above ground increases. Protection is provided by sprinkling in two ways. The temperature of the water applied is above freezing by a certain number of degrees. To lower the temperature of the water to freezing, heat must be withdrawn from it. To freeze water, an additional amount of heat must be removed from it. This is called the heat of fusion of water. In sprinkler frost protection, the heat removed to lower the water temperature and the heat of fusion when ice freezes is absorbed by the vegetation and soil surface. This will continue until all the water has frozen. The fact that there is ice on the surfaces of the plants will not keep the surfaces from falling below freezing. For this reason, sprinkling should be continued until the air temperature is above freezing and the ice has melted.

The entire field must be covered with a fine mist during freezing temperatures. Therefore, only the permanent or set type sprinkler systems can be utilized for frost protection. The center pivot and other moving systems cannot be adapted to cover an entire field at one time.

For frost protection, the wetted area from one sprinkler should overlap to provide as uniform as possible precipitation rate. Following are guidelines to relate precipitation rates to associated temperature protection.

Prec. rate in./hr.	0.08	0.10	0.14	0.18
Minimum temp. $^{\circ}F$	28°	26°	23°	20°

Application of Fertilizers

Dissolving soluble fertilizers in water and applying the solution through a sprinkler system is quick, economical, easy, and effective. A minimum of equipment is required, and once the apparatus for adding the fertilizer to the irrigation water is set up, the crop being irrigated can be fertilized with less effort than is required for mechanical application. In fact, both irrigation and fertilization can be accomplished with only slightly more labor than is required for irrigation alone, especially if irrigation and fertilizer application can be scheduled to coincide.

The uniformity of the fertilizer application is only as good as the uniformity of water application. However, close control over the placement depth of fertilizer is possible.

Continuous move systems require a constant flow and concentration of nutrients into the system in order to get even distribution within a field. Set type systems permit variations in the concentration and flow into the system since all portions of a field are being treated for a specific time period and at any instant all will be receiving the same concentration.

The system should be operated at least 30 minutes with clear water to rinse fertilizer from the system and off of the plant foliage.

Fertilizers may be injected into the sprinkler system by any one of several methods. The simplest is to introduce the fertilizer at the suction side of a centrifugal pump. Another common method is to introduce the fertilizer solution with a gear pump discharging into the main line of the system.

One of the disadvantages of applying fertilizer with sprinkler equipment is that the fertilizer cannot be placed in specific locations in the soil such as conventional bands. Fertilizer applied through the irrigation water will be distributed throughout the plant root zone. Further, when irrigation application rates exceed the maximum soil infiltration rate, runoff will occur. Irrigation water containing nutrients that are not absorbed by the soil are more serious than the runoff water alone.